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Nesting of the keyhole wasp *Pachodynerus nasidens* (Latreille, 1812) (Vespidae, Eumeninae) in a nest of a paper wasp (Vespidae, Polistinae)

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Abstract

Potter wasps (Hymenoptera, Vespidae, Eumeninae) adopt different substrates for nesting, including other wasp nests. Nevertheless, such behavior rarely occurs with abandoned nests of the paper wasps (Hymenoptera, Vespidae, Polistinae). In this study, we report the occurrence involving the nesting of a potter wasp on a paper wasp's nest. Such a record occurred in November 2021 in a segment of a deciduous forest, at Mata Seca State Park, Southeast Brazil. An abandoned Polistinae nest was found, with 14 cells sealed with mud, from which four male *Pachodynerus nasidens* individuals emerged. This record of *P. nasidens* reusing a Polistinae's nest increases our knowledge of Eumeninae nesting strategies and on possible associations between different groups of vespid wasps.

Keywords

Neotropical wasps, nest abandonment, nesting strategy, social wasp

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Introduction

The Vespidae family includes around 5300 species (Piekarski et al. 2018), which present diverse nesting and social behaviors (Iwata 1976; Cowan 1991). Among Neotropical vespids, two taxa stand out in this regard: Eumeninae, with 3404 species (Piekarski et al. 2018), usually builds their nests with mud and are commonly classified as solitary wasps (Hermes et al. 2014); and Polistinae, with 1003 species (Piekarski et al. 2018), uses macerated cellulose for nesting and presents eusocial behavior (Somavilla and Carpenter 2021). Several ecosystem services are attributed to these insects, including floral visiting (Pires et al. 2022) and biological control of agricultural pests (Jacques et al. 2020), which demonstrates their ecological and economic importance (Brock et al. 2021).

Records of other insects reusing nests of Polistinae wasps are scarce (Bakar et al. 2015). For example, Pinto (2005), recorded solitary bee *Tetrapedia diversipes* Klug, 1810 reusing nests of *Polistes*, affirming that nests without an envelope were more propitious for reuse. Rau (1928) also reported the reuse of *Polistes* nests by species of Apoidea: *Trypoxylon* Latreille, 1796 and *Osmia* Panzer, 1806. There are also reports of the use of abandoned Polistinae nests by solitary wasps of the subfamily Eumeninae (Rau, 1944), who recorded the reuse of old Polistes nests by *Euodynerus foraminatus* (de Saussure, 1853) and *Paracinstrocerus fulvipes* (de Saussure 1856). Here, we add information to this ecological condition, with a report of the occurrence of the species of Eumeninae *Pachodynerus nasidens* (Latreille, 1812) reusing a Polistinae nest, recorded in a Neotropical seasonal forest, in Southeast Brazil.

Methods

We made this observation on November 30th, 2021, at the beginning of the rainy season, in the Mata Seca State Park, an Integral Protection Conservation Unit, situated in the municipalities of Manga and Itacarambi, the northern part of the State of Minas Gerais, Brazil (14°52'0"S, 43°59'58"W). This region houses deciduous forest remnants, the phytophysiognomy of the Atlantic Rainforest Domain. More than 50% of arboreous species are deciduous, characterized by the intensive loss of leaves in response to the two defined seasons of the year: rainy (spring/summer) and dry (fall/winter) (Belém et al. 2021).

We carried out the photographic record in the field, with a digital camera Nikon 60x Optical Zoom Wide. The nest was collected and stored in a glass recipient topped with a net, allowing gas exchange with the external environment and avoiding escape by the insects which would emerge from the occupied cells. Nest observations were performed daily until the imagoes emerged, at the Zoology Laboratory, in the Federal Institute of Education, Science, and Technology of South Minas Gerais – IFSULDEMINAS, Campus Inconfidentes.

To identify the genus of Polistinae that would have produced the nest, we adopted the dichotomous key of Barbosa et al. (2021) and compared the nest with others stored

in the IFSULDEMINAS entomological collection. The nest length and diameter were measured, in addition to the dimensions of the collected specimens, using a pachymeter, 0.2 mm precise. The number and relative position of both empty and sealed cells were also registered. To identify the individuals that emerged from the occupied reused cells, a stereoscopic microscope Leica S8 APO was used and the dichotomous key of Carpenter and Garcete-Barrett (2002 [2003]) at the genus level, and the dichotomic criteria presented by Willink and Roig-Alsina (1998), at the specific level, were employed.

Results

We found one Polistinae nest, built on the plant species *Quiabentia zehntneri* (Britton & Rose) Britton & Rose (Cactaceae). This nest is of the gymnodomous type (Richards and Richards 1951; Barbosa et al. 2021), without a protection envelope, 154.2 mm in length (pedicel to the basis), and 40 mm in width. It contained a total of 223 counted cells, 14 of which were sealed with mud, indicating the probable presence of solitary wasps (Fig. 1). Four of the sealed cells belonged to the medium portion of the nest, and the other 10 cells, to the superior portion, 20 mm from the pedicel.

Two weeks after the field collection, on December 14th, 2021, four male individuals of *Pachodynerus nasidens* (Latreille, 1812) emerged from the cells at the nest medium portion. These cells were situated around 60 mm above the basis, with an average diameter of 6.2 mm. *P. nasidens* sealed the cells' entrance and underlaid their bottom, having emerged one adult individual for each cell.

Individuals emerging from these cells presented average measurements of 7.395 mm in body length, 2.68 mm in mesosoma width, and 3.485 mm in T2 width. These male individuals presented average dimensions, relatively smaller than those presented by *P. nasidens* females deposited in the Entomological Collection of Federal University of Lavras (CEUFLA) (9.03 mm in body length, 3.78 mm in mesosoma width, 3.485 mm in T2 width). The other 10 sealed cells presented an average diameter of 5.74 mm; we did not observe emergence from them until May 1st, 2022.

Discussion

Nests completely built by *P. nasidens* are rare. This species commonly acts as an inquiline, in cavities made by humans (House et al. 2020) or in abandoned nests of other hymenopterans (Freeman and Jayasingh 1975; Matthews and González 2004). *P. nasidens* also build mud structures in the ground and fixed to plants (Carpenter 1986). The use of abandoned cavities in cells of a Polistinae nest seems to be one more case of the species' plasticity in nesting behavior.

Pachodynerus nasidens nesting peaks occur in months of higher temperature and humidity throughout the year (House et al. 2020). The ideal temperature for egg development ranges from 26 to 31 °C (Jayasing and Taffe 1982), while higher humidity

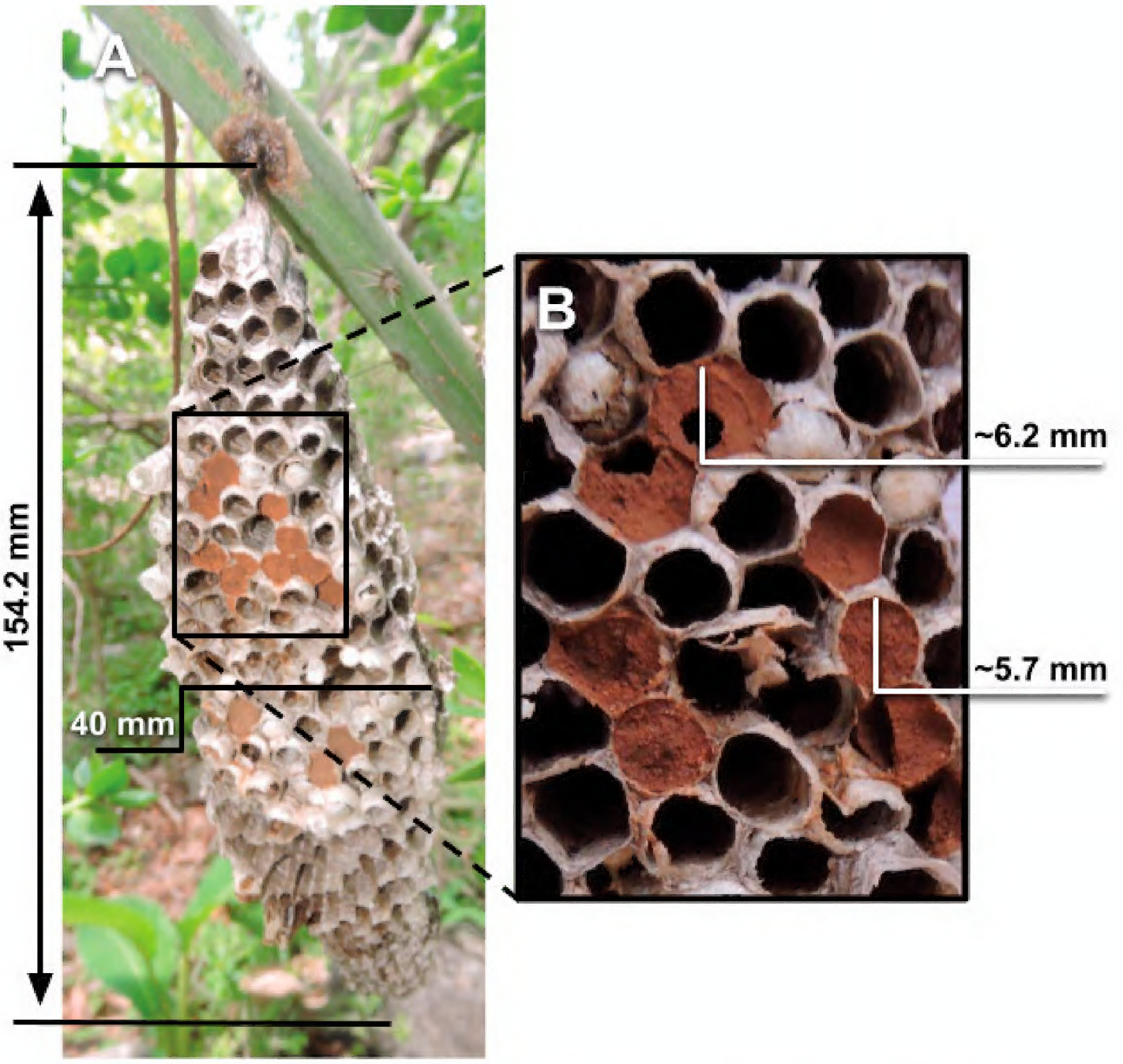

Figure 1. Polistinae's abandoned nest **A** with sealed cells occupied **B** by juveniles of the *Pachodynerus nasidens* solitary species (Vespidae, Eumeninae).

ensures the availability of water and mud for nest building (Freeman and Jayasingh 1975), explaining our record in the hot and humid season.

The nesting preference of *P. nasidens* is for cavities with openings of 6 to 9 mm in diameter (Bequaert 1948; Oliveira-Nascimento and Garófalo 2014), which explains the use of Polistinae cells, which have 6.2 mm in average diameter. The exclusive emergence of male individuals, smaller than females from the same collection, may be related to the cell size of the Polistinae nest, which may be too small for females' development. In this species, feminine eggs are usually elongated in comparison with masculine ones. Additionally, female immatures develop more slowly and need more food, consequently needing a bigger physical space for development (Jayasingh 1980; Jayasingh and Taffe 1982).

The nest herein described probably belonged to *Polistes versicolor* (Olivier, 1791). According to the dichotomous key presented by Barbosa et al. (2021), we conclude that this nest was produced by *Polistes* social wasp genus. Close to the abandoned nest, we found nests of *P. versicolor*, including one being built on *Q. zehntneri*

(Moura et al. 2022). In another study (Jacques et al. in press) the Polistinae diversity on social wasps from the Mata Seca State Park is presented, in which only nests of this species of the genus *Polistes* genus were found.

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